PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(PCT Rule 71.1)

Date of mailing *(day/month/year)*	02.02.2006
Applicant's or agent's file reference: G5443 PCT	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2005/000450	18.01.2005	11.02.2004

Applicant: UMICORE AG & CO. KG et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary report on patentability and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary report on patentability. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international preliminary examining authority:

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PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference G5443 PCT	**FOR FURTHER ACTION**	See Form PCT/IPEA/416
International application No. PCT/EP2005/000450	International filing date *(day/month/year)* 18.01.2005	Priority date *(day/month/year)* 11.02.2004
International Patent Classification (IPC) or national classification and IPC B01D53/94		
Applicant UMICORE AG & CO. KG et al.		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *sent to the applicant and to the International Bureau)* a total of 4 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

☒	Box No. I	Basis of the opinion
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☒	Box No. VIII	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
12.12.2005	02.02.2006
Name and mailing address of the international preliminary examining authority: European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Bogaerts, M Telephone No. +31 70 340-2335

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:

   ☐ international search (under Rules 12.3 and 23.1(b))
   ☐ publication of the international application (under Rule 12.4)
   ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-12	as originally filed

Claims, Numbers

1-19	received on 12.12.2005 with letter of 12.12.2005

Drawings, Sheets

1/3-3/3	as originally filed

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:

   ☐ the description, pages
   ☐ the claims, Nos.
   ☐ the drawings, sheets/figs
   ☐ the sequence listing *(specify)*:
   ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

   ☐ the description, pages
   ☐ the claims, Nos.
   ☐ the drawings, sheets/figs
   ☐ the sequence listing *(specify)*:
   ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-19
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-19
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-19
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V:

Reference is made to the following documents:
D1: US-A1-2004/0001782
D2: WO-A-01/74476

1. The subject-matter of claim 1 differs from D1/D2 mainly in that the precious metal component exhibits a continuously varying concentration profile in three abutting regions as defined in the claim.
   The subject-matter of claim 1 is thus new (Article 33(2) PCT).

2.1 The problem to be solved by the present invention appears to be to provide a catalyst with an improved resistance to aging (table on page 12).

2.2 D1 and D2 do not address such a problem, nor do they give a hint to the claimed solution.

2.3 The subject-matter of claim 1 involves an inventive step (Article 33(3) PCT).

3. Claim 11-13 relate to methods for making the catalyst of claim 1 and as such are also novel and inventive.

Re Item VIII:

1. By the deletion of "of the respective precious metal" in claim 1 it is no longer unambiguously clear that the "concentration" relates to the concentration of precious metal. However the claim has been interpreted in this way.

2. Although claims 11,12 and 13 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and/or in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.

Claims

1. An exhaust gas cleaning catalyst comprising on a honeycomb carrier a catalytic coating, said honeycomb carrier having an upstream end and a downstream end and a plurality of flow channels running from the upstream end to the downstream end, wherein the catalytic coating comprises at least one catalytically active precious metal component which exhibits a continuously varying concentration profile along the axis of the honeycomb carrier wherein the honeycomb carrier is distinguished into three abutting regions with a low concentration ~~of the respective precious metal~~ in the first or upstream region ~~a maximum concentration~~ in the second or intermediate region and a third concentration in the third or downstream region which is equal to or lower than the ~~maximum~~ peak concentration in the second region.

2. Exhaust gas cleaning catalyst according to claim 1, wherein the total length of the honeycomb carrier is from 30 to 300 mm and the first region has a length of from 5 to 20 mm and the second region has a length of from 10 to 100 mm abutting to the first region.

3. Exhaust gas cleaning catalyst according to Claim 2, wherein the average concentration of the precious metal component with continuously varying concentration profile in the first region is of from 10 to 80 % of the maximum concentration in the second region and the average concentration in the third region is of from 0 to 100 % the maximum concentration in the second region.

4. Exhaust gas cleaning catalyst according to Claim 3, wherein the concentration of precious metal is constant within the ~~individual~~ third regions.

5. Exhaust gas cleaning catalyst according to Claim 3, wherein the precious metal component with continuously varying concentration profile is palladium and its ~~maximum~~ peak concentration in the second region is from 0,1 to 100 g/l of volume of the honeycomb carrier.

~~6. Exhaust gas cleaning catalyst according to Claim 4, wherein the concentration of palladium is continuously varying along the axis of the honeycomb carrier with a minimum concentration~~ at the inlet face of the carrier and with a steep increase to a peak concentration ~~within the second region of the catalyst carrier.~~

6. (Amended) Exhaust gas cleaning catalyst according to one of the preceding Claims, wherein the catalytic coating further comprises additional precious metal components se-

lected from the group consisting of platinum, rhodium, iridium or mixtures thereof.

7. (6) Exhaust gas cleaning catalyst according to claim 1, wherein the additional precious metal components exhibit the same concentration profile as palladium but with different absolute concentrations.

8. (6) Exhaust gas cleaning catalyst according to Claim 1, wherein the additional precious metal components have the same constant concentration within all three regions of the catalyst.

9. (8) Exhaust gas cleaning catalyst according to Claim ~~8~~ wherein the additional precious metal components are platinum and rhodium with platinum and rhodium being present in a concentration of from 0,05 to 5 g/l volume of the honeycomb carrier.

10. (9) Exhaust gas cleaning catalyst according to Claim ~~9~~, wherein the catalytic coating with the varying concentration profile forms a first coating on top of which is provided a second catalytic coating and said second catalytic coating comprises the additional precious metal components with constant concentration along the honeycomb carrier.

11. Process for manufacturing an exhaust gas cleaning catalyst according to claim 1, comprising

a) coating a honeycomb carrier with a slurry comprising at least one high surface area support material for the precious metal component, drying and calcining this coating to obtain a support layer,

b) wetting the first region of the carrier with a wetting agent,

c) impregnating the first and second region of the carrier with a solution of at least one precursor compound of the precious metal component,

d) drying the impregnated support layer by conducting a stream of heated air through the honeycomb carrier, thereby forming a continuous concentration profile with a low precious metal concentration at the upstream side, and

e) calcining and optionally reducing the precious metal component in a hydrogen containing gas stream.

12.

A31 Process for manufacturing an exhaust gas cleaning catalyst according to claim 1, comprising

a) coating a honeycomb carrier with a slurry comprising at least one high surface area support material and a precious metal component, drying and calcining this coating to obtain an already catalytically activated support layer,

b) wetting the first region of the carrier with a wetting agent,

c) impregnating the first and second region of the carrier with a solution of at least one precursor compound of the precious metal component,

d) drying the impregnated support layer by conducting a stream of heated air through the honeycomb carrier, thereby forming a continuous concentration profile with a low precious metal concentration at the upstream side, and

e) calcining and optionally reducing the precious metal component in a hydrogen containing gas stream.

13.

A47 Process for manufacturing an exhaust gas cleaning catalyst according to claim 1, comprising

a) coating a honeycomb carrier with a slurry comprising at least one high surface area support material for the precious metal component, drying and calcining this coating to obtain a support layer,

b) wetting the first and the third region of the carrier with a wetting agent,

c) impregnating either the complete carrier with a solution of at least one precursor compound of the precious metal component in one step, or in a first impregnation step the first and second region and in a second impregnation step the third and the second region of the carrier,

d) drying the impregnated support layer by conducting a stream of heated air through the honeycomb carrier, thereby forming a continuous concentration profile with a low precious metal concentration at the upstream side, and

e) calcining and optionally reducing the precious metal component in a hydrogen containing gas stream.

14.

A51 Process according to one of Claims 11 to 13, wherein the wetting agent is water or an aqueous solution of an organic compound.

15. (~~16~~) Process according to Claim 14, wherein the wetting agent is an aqueous solution of an organic compound selected from the group consisting of polyethylene glycol, citric acid, polyvinyl alcohol, isopropanol or mixtures thereof,

16. (~~17~~) Process according to one of Claims 11 to 13, wherein the impregnation solution contains a poorly adsorbing precursor of the precious metal component.

17. (~~18~~) Process according to Claim 16, wherein the poorly adsorbing precursor compound is palladium tetraammine nitrate $Pd(NH_3)_4(NO_3)_2$.

18. (~~19~~) Process according to one of Claims 11 to 13, wherein the impregnation solution contains a strongly adsorbing precursor of the precious metal component.

19. (~~20~~) Process according to Claim 18, wherein the strongly adsorbing precursor compound is palladium nitrate $Pd(NO_3)_2$.